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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/822,414	04/02/2001	Hiroya Kirimura	P107351-00011	9442

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EXAMINER	
SONG, MATTHEW J	
ART UNIT	**PAPER NUMBER**
1765	

DATE MAILED: 02/26/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

Office Action Summary	Application No.	Applicant(s)
	09/822,414	KIRIMURA ET AL.
	Examiner	**Art Unit**
	Matthew J Song	1765

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on *18 December 2002*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *16-32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *16-32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 16, 18 and 31-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976).

Zhang et al discloses a method of annealing a semiconductor, as noted in the entire reference, where a multi-chamber apparatus is used so that an amorphous silicon film having subjected to theremal annealing can be put to a subsequent laser crystallization step without exposing its surface to air (col 6, ln 1-5). Zhang et al discloses a plasma CVD apparatus **2** for depositing amorphous silicon and a chamber **4** to effect therein laser crystallization of the film (col 6, ln 6-67). Zhang et al also discloses a plasma CVD chamber **13** is loaded with a substrate and a CVD formation of an amorphous silicon film with a starting gas of SiH_4 diluted with hydrogen and after the formation of the silicon film, the substrate is transferred to a laser processing chamber and a laser light is emitted into the chamber from a KrF excimer laser, this reads on applicant's energy beam irradiating device, to crystallize the amorphous silicon film (col 7, ln 1-67 and col 8, ln 1-55).

Zhang et al teaches a multi-chamber apparatus. Zhang et al does not teach a single chamber apparatus.

In a method forming multi-layered structures in a single chamber, note entire reference, Schachameyer et al teaches a single chamber semiconductor processing chamber **2**, a semiconductor wafer substrate **4** placed in the chamber on a pedestal support **6**, an excimer ultraviolet laser **20** introduced through port **20** to impinge on the wafer **4.** Schachameyer et al also teaches radiation is introduced into the chamber to react with a gas to expitaxially deposit a first layer (Fig 1 and col 1, ln 40 to col 2, ln 55). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Zhang et al with Schachameyer et al's single chamber with an excimer laser because the irradiation step can be conducted in the same chamber and with the same equipment, thus significantly improving manufacturing efficiency (col 2, ln 35-55 and col 1, ln 5-35).

Referring to claim 18 and 31-32, Zhang et al discloses a plasma CVD method.

3. Claims 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976) as applied to claims16, 18 and 31-32 above, and further in view of Fan et al (US 4,309,225).

The combination of Zhang et al and Schachameyer et al teach all of the limitations of claim 17 including a film forming device with a structure that can from the pre-film over a length **2** and an energy beam irradiation device with a structure that can irradiate the target surface of the substrate over a length (col 8, ln 15-25), as discussed previously in claim 16, except operating the energy beam irradiation device to irradiate the formed pre-film with the energy beam while moving the substrate in a second direction crossing the first direction.

In a method of forming an amorphous material with a moving energy beam, Fan et al teaches how to provide continuous, controlled motion of a crystallization front in an amorphous material by controlling parameters such as the rate at which a laser beam or other beam of energy is moved across an amorphous material (col 2, ln 1-67). Fan et al also discloses scanning of a semiconductor can be achieved by mounting a sample chamber on translational stages **28**,**30** and **32** provide the capability to move the chamber and thus the semiconductor in the x, y, and z directions, this reads on applicant's moving the substrate in a second directions. Fan et al also discloses each stage can be driven separately or simultaneously and the rate at which each stage can be driven is variable (col 4, ln 25-67; col 5, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zhang et al and Schachameyer et al with Fan et al to obtain continuous, controlled motion of a crystallization front in an amorphous material.

4. Claims 17, 19 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976) as applied to claims 16,18 and 31-32 above, and further in view of Asakawa et al (US 5,795,385).

The combination of Zhang et al and Schachameyer et al teach all of the limitations of claim 17 including a film forming device with a structure that can from the pre-film over a length **2** and an energy beam irradiation device with a structure that can irradiate the target surface of the substrate over a length (col 8, ln 15-25), as discussed previously in claim 16, except operating the energy beam irradiation device to irradiate the formed pre-film with the energy beam while moving the substrate in a second direction crossing the first direction.

In a method of forming a single crystalline thin film by beam irradiation, Asakawa et al teaches an amorphous substrate using plasma chemical vapor deposition while simultaneously irradiating the substrate with beams of low energy gas (col 4, ln 30-67). Asakawa et al teaches the substrate can be scanned by a substrate moving means, whereby it is possible to from a single crystalline thin film having high homogeneity on a long substrate (col 10, ln 5-45; Eleventh Preferred Embodiment). Asakawa et al also teaches it is possible to facilitate formation of an amorphous thin film by intermittently applying beams from an ion source while regularly supplying a reaction gas and rotating the substrate during application pauses (col 12, ln 1-50). Asakawa et al also teaches neon ions can be accelerated to 200-600 eV by an ion source **83** (col 23, ln 20-55). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zhang et al and Schachameyer et al with Asakawa et al to form a thin film having high homogeneity on a long substrate.

Referring to claim 19, the combination of Zhang et al, Schachameyer et al and Asakawa et al teaches a pre-film of the crystalline silicon film is formed on the target surface while emitting an ion beam to the substrate in the step of form the pre-film by the film forming device ('385 col 4, ln 50-67).

Referring to claim 23, the combination of Zhang et al, Schachameyer et al and Asakawa et al teaches formation of an amorphous film by intermittently applying beams from an ion source while supplying reaction gas, this reads on applicant's ion beam is emitted to the target surface of the substrate in an initial stage of the forming of the pre-film.

5. Claim 21, 23, 25 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976) and Asakawa et al (US 5,795,385) or Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976) and Fan et al (US 4,309,225) applied to claims 17 above, and further in view of Selvakumar et al (US 5,633,194).

The combination of Zhang et al, Schachameyer et al and Asakawa et al or the combination of Zhang et al, Schachameyer et al and Fan et al teaches all of the limitations of claim 21, as discussed previously in claim 17, an ion beam is emitted to the target surface of the substrate from the ion source prior to the step of forming the pre-film

In a method of forming epitaxial grown Si utilizing ion beams (col 1, ln 35-65), Selvakumar et al teaches in-situ cleaning of a substrate surface by argon ion bombardment prior to the start of deposition, where a 200 eV argon ion beam was used to sputter clean the substrate in a necessary step which significantly influences the quality of a grown film by removing native oxide. Selvakumar et al also discloses an inexpensive ion beam vapor deposition technique used to grow silicon films, where an ion source **13** was used to ionize a gas to accelerate an ion beam towards a substrate with a current between 30-1000 eV using high purity argon and silane gases as sources for the ion beam (col 6, ln 20-65; col 7, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zhang et al, Schachameyer et al and Asakawa et al or the combination of Zhang et al, Schachameyer et al and Fan et al with Selvakumar et al to clean the substrate.

Referring to claim 30, Overlapping ranges are held to be obvious (MPEP 2144.05).

6. Claims 20, 22, and 26-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976), as applied to claims 16, 18 and 31-32 above, and further in view of Selvakumar et al (US 5,633,194).

The combination of Zhang et al and Schachameyer et al teach all of the limitations of claim 20, as discussed previously in claim 16, except an ion beam is emitted to the target surface of the substrate from the ion source prior to the step of forming the pre-film.

In a method of forming epitaxial grown Si utilizing ion beams (col 1, ln 35-65), Selvakumar et al teaches in-situ cleaning of a substrate surface by argon ion bombardment prior to the start of deposition, where a 200 eV argon ion beam was used to sputter clean the substrate in a necessary step which significantly influences the quality of a grown film by removing native oxide. Selvakumar et al also discloses an inexpensive ion beam vapor deposition technique used to grow silicon films, where an ion source **13** was used to ionize a gas to accelerate an ion beam towards a substrate with a current between 30-1000 eV using high purity argon and silane gases as sources for the ion beam (col 6, ln 20-65; col 7, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zhang et al and Schachameyer et al with Selvakumar et al to clean the substrate.

Referring to claim 26-29, the combination of Zhang et al, Schachameyer et al and Selvakumar et al teaches an ion beam where a current can be adjusted between 30-1000 eV and a cleaning at 200 eV. Overlapping ranges are held to be obvious (MPEP 2144.05).

7. Claims 20, 22, 24, and 26-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976), as applied to claims 16, 18 and 31-32 above, and further in view of Ichikawa et al (US 5,484,746).

The combination of Zhang et al and Schachameyer et al teaches all of the limitations of claim 20, as discussed previously in claim 16, except an ion beam is emitted to the target surface of the substrate from the ion source prior to the step of forming the pre-film.

In a process of forming a semiconductor thin film, Ichikawa et al teaches cleaning surface adherents is performed by use of ions controlled in magnitude of energy (i.e. claim 20) and it is desirable that the surface cleaning step and the later deposition step of an amorphous semiconductor layer should be performed continuously so that no contaminant may be adsorbed. Ichikawa et al also teaches removing surface adherents with ions has been realized within sputtering apparatus in the form of cleaning of a silicon surface with argon ions, this reads on applicant's ion beam is emitted to the target surface prior to the step of forming the pre-film, and by performing sputtering film formation in the same apparatus immediately after the cleaning step, thin films exhibiting various crystallinity from single crystal silicon to amorphous silicon which are dependent on the irradiation energy to the substrate can be deposited on the silicon substrate (col 3, ln 1-67). Ichikawa et al also teaches sputtering a target is caused to occur by irradiations of argon (i.e. claim 18) and a power source **109** for supplying energy in the cleaning step (col 4, ln 1-67). Ichikawa et al also teaches sputter cleaning of a semiconductor with argon has been also used as the pre-treatment of low temperature silicon epitaxial growth by CVD with argon ions generally more than 100 eV are used at a lowered processing temperature (col 1, ln 20-67; col 2, ln 1-45). It would have been obvious to a person of ordinary skill in the art at the

time of the invention to modify the combination of Zhang et al and Schachameyer et al with Ichikawa et al to remove surface adherents from a substrate

Referring to claim 22, the combination of Zhang et al, Schachameyer et al and Ichikawa et al teaches an ion source in an initial stage of the step of forming the pre-film by the film forming device (col 3, ln 10-35).

Referring to claim 24, the combination of Zhang et al, Schachameyer et al and Ichikawa et al teaches cleaning with an ion beam and sputtering with an ion beam continuously, this reads on applicant's ion beam is emitted to the target surface of the substrate during a period from a stage before the pre-film forming step and forming device to an initial stage of the pre-film forming step.

Referring to claim 26-29, Overlapping ranges are held to be obvious (MPEP 2144.05).

8. Claims 21, 23, 25 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976) and Fan et al (US 4,309,225) as applied to claim 17 above, and further in view of Ichikawa et al (US 5,484,746).

The combination of Zhang et al, Schachameyer et al and Fan et al teach all of the limitations of claim 21, as discussed previously in claim 17, except emitting an ion beam to a target surface of a substrate prior to the step of forming the pre-film by the film forming device.

In a process of forming a semiconductor thin film, Ichikawa et al teaches cleaning surface adherents is performed by use of ions controlled in magnitude of energy (i.e. claim 20) and it is desirable that the surface cleaning step and the later deposition step of an amorphous semiconductor layer should be performed continuously so that no contaminant may be adsorbed.

Ichikawa et al also teaches removing surface adherents with ions has been realized within sputtering apparatus in the form of cleaning of a silicon surface with argon ions, this reads on applicant's ion beam is emitted to the target surface prior to the step of forming the pre-film, and by performing sputtering film formation in the same apparatus immediately after the cleaning step, thin films exhibiting various crystallinity from single crystal silicon to amorphous silicon which are dependent on the irradiation energy to the substrate can be deposited on the silicon substrate (col 3, ln 1-67). Ichikawa et al also teaches sputtering a target is caused to occur by irradiations of argon (i.e. claim 18) and a power source **109** for supplying energy in the cleaning step (col 4, ln 1-67). Ichikawa et al also teaches sputter cleaning of a semiconductor with argon has been also used as the pre-treatment of low temperature silicon epitaxial growth by CVD with argon ions generally more than 100 eV are used at a lowered processing temperature (col 1, ln 20-67; col 2, ln 1-45). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zhang et al, Schachameyer et al and Fan et al with Ichikawa et al to remove surface adherents from a substrate

Referring to claim 23, the combination of Zhang et al, Schachameyer et al, Fan et al and Ichikawa et al teaches an ion source in an initial stage of the step of forming the pre-film by the film forming device (' 746 col 3, ln 10-35).

Referring to claim 25, the combination of Zhang et al, Schachameyer et al, Fan et al and Ichikawa et al teaches cleaning with an ion beam and sputtering with an ion beam continuously, this reads on applicant's ion beam is emitted to the target surface of the substrate during a period from a stage before the pre-film forming step and forming device to an initial stage of the pre-film forming step.

Referring to claim 30, Overlapping ranges are held to be obvious (MPEP 2144.05).

9. Claims 22 and 28-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al (US 5,578,520) in view of Schachameyer et al (US 4,685,976), as applied to claims 16, 18 and 31-32 above, and further in view of Krimmel (US 4,140,546).

The combination of Zhang et al and Schachameyer et al teach all of the limitations of claim 22, as discussed previously in claim 16, except an ion beam is emitted to the target surface of the substrate from an ion source in an initial stage of the step of forming the pre-film by the film forming device.

In a method of producing a monocrystalline layer of a substrate (col 1-8), Krimmel teaches an electron beam vaporizer means may be utilized to produce a vapor flux of a material being deposited and to produce an ion flux which contains ions composed of a material being vapor deposited (col 4, ln 20-50). Krimmel also teaches a silicon substrate **6**, vaporizing material, which is deposited on the substrate and simultaneously ions are accelerated to the surface of the substrate, this reads on applicant's initial stage of forming the pre-film (col 5, ln 10-55). Krimmel also teaches an ion flux having an energy of 10 keV (claim 1). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Zhang et al and Schachameyer et al with Krimmel's ion beam to increase adhesive strength and increase a corrosion barrier for the material grown (col 3, ln 25-40).

Response to Arguments

10. Applicant's arguments with respect to claims 16-32 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 703-305-4953. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin L Utech can be reached on 703-308-3868. The fax phone numbers for the

organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Matthew J Song
Examiner
Art Unit 1765

MJS
February 20, 2003

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